

A Study of Pricing over Space in Railroad Markets

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A group of academic economists working with the Army Corps of Engineers to develop the economics underlying benefit measurement of investments in the waterways.

- Choice modeling
- Spatial Equilibrium
- Spatial Econometrics
- Congestion modeling
- Port Efficiency
- Port Choice
- Forecasting transportation traffic.

All research on
www.Corpsnets.us and there is a link to a monthly newsletter called
Nets News link

This is one paper in the sequence to examine the competitive relationship between railroads and the waterways.

Introduction

- Most railroad shippers have service from one railroad. These are “captive” shippers.
- Deregulation and merger activity increased the number of captive shippers over the last 25 years.
- But, even captive shippers have options. These include: other products, destinations, modes, and various combinations.
- These are the original market dominance criteria of the ICC.

Introduction

- Our focus is on waterways, but there are lots of different potentially constraining options.
- Our results indicate that both inter- and intra-modal competition, as well as competition from other industries constrain railroad pricing power.

Key Empirical Papers

- MacDonald (1987) uses the Waybill data set to examine the impact of barge competition on rail rates for shipments of wheat, corn and soybeans
- Burton (1995) also uses the Waybill data set to explore the effects of barge competition on rail rates for a variety of goods

Theoretical Model

- The focus of our work is on the rail shipments originating from various points in geographic space
- Shippers maximize profits by simultaneously choosing both the destination market for their product, and their mode of transportation (truck, rail, barge)

Theoretical Model

- Railroads recognize the shipper's profit maximization problem and choose the rail rate to charge the shipper by solving:

$$\begin{aligned} \max_{r_{Rd}} p &= r_{Rd} X_{Rd}(P_d, r_{md}) - C(X_{Rd}(P_d, r_{md})) \\ \text{s.t. } p_{Rd} &\leq p_i \quad i = 1, \dots, rd \end{aligned}$$

Theoretical Model

- This leads to a first order condition

$$(r - mc) / r = (\lambda - 1) / \varepsilon$$

λ =Constraint on market power (=1 if $r=mc$, and 0 if monopoly rate, between 0 and 1 “constrained market dominant”).

We use this to frame our empirical model:

Theoretical Model

- Directly from the first order conditions, it can be shown that the railroad's profit maximizing rate is:

$$\log (r_R) = \log (MC) - \log (\textit{markup})$$

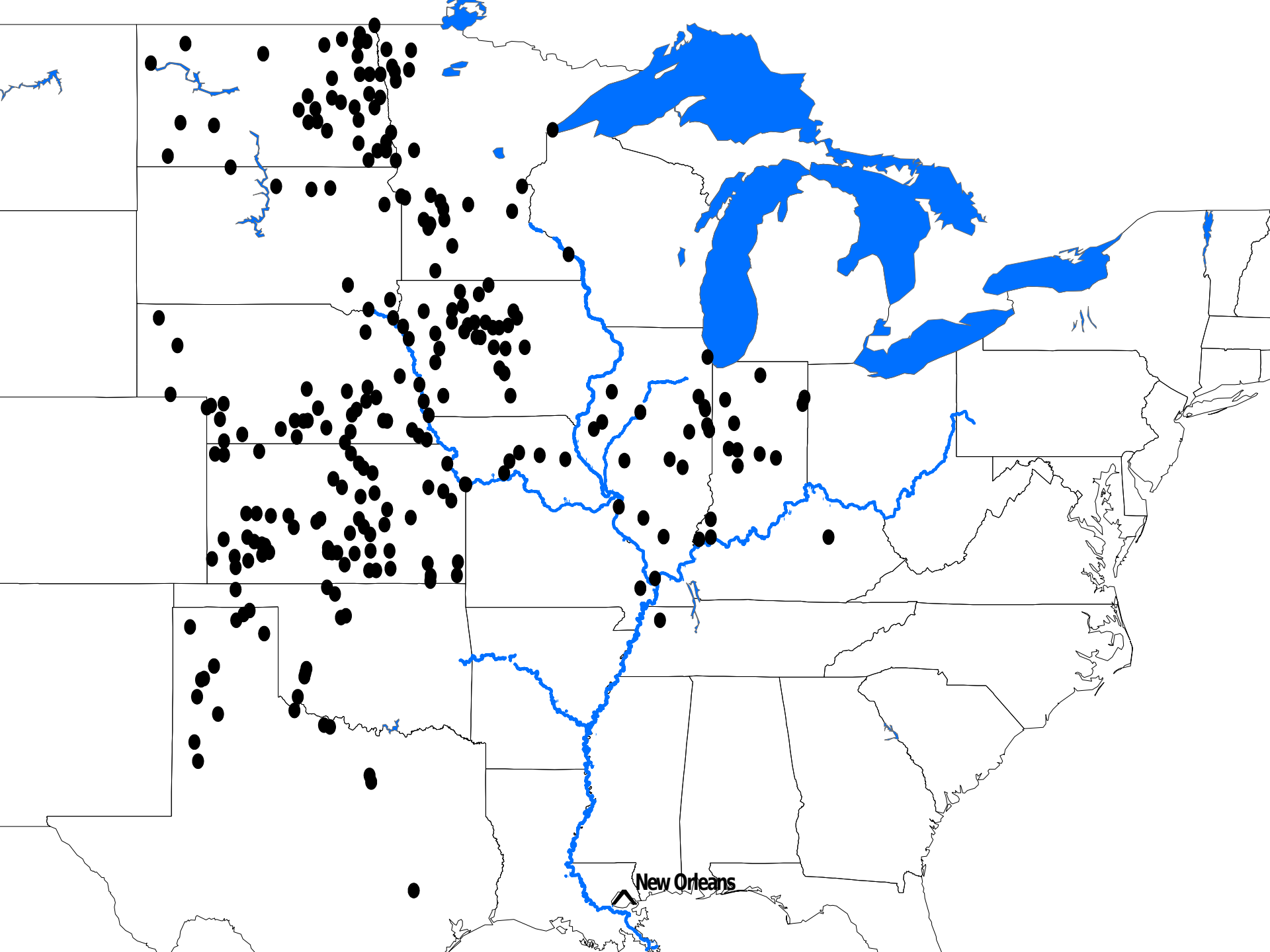
- Where the markup term is a function of the competitive options available to the shipper.

Variables

- Note that the cost variables are observable to us and include:
 - The distance of the shipment,
 - The volume of the shipment, and
 - Whether the shipment is part of a unit train or not
- The markup variables include:
 - The distance to the nearest waterway, and
 - The existence of alternative markets

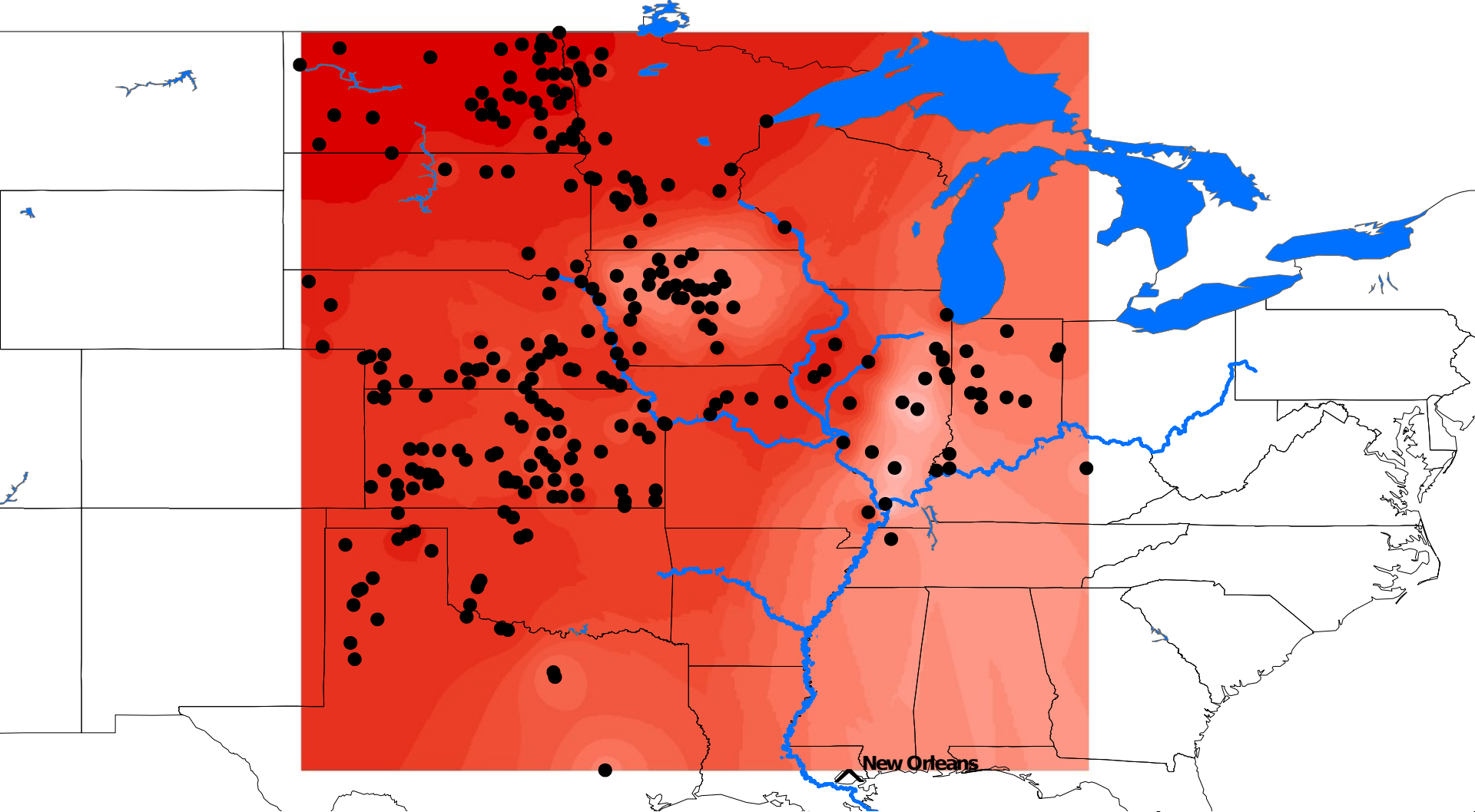
Data

- The geographic “shipper” locations come from the Farm Service Agency’s Warehouse Database
- Randomly selected from states which are 1st or 2nd degree contiguous to the Mississippi River:

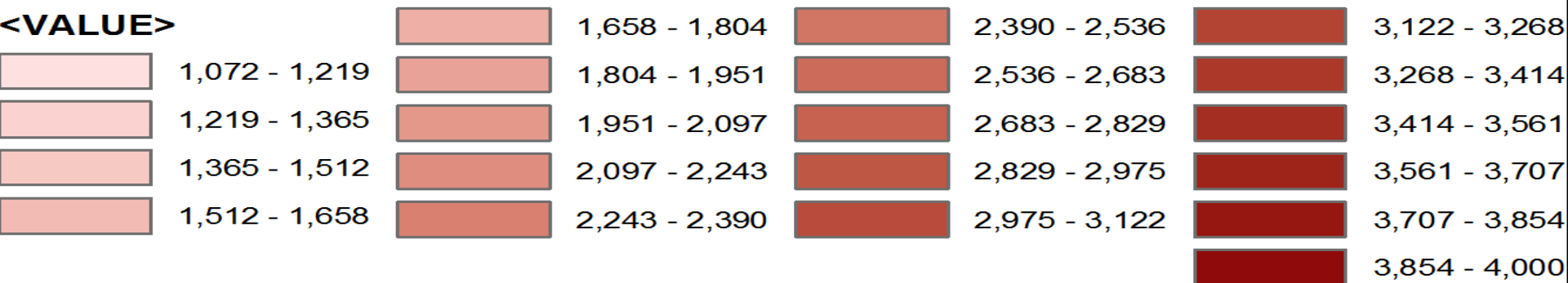


Data

- Rail rates collected for each location directly from service providers via their websites
- Rates obtained for shipments of corn to the Gulf Coast and to Portland, Oregon
- Service providers offer different rates for different volumes shipped with average rates:



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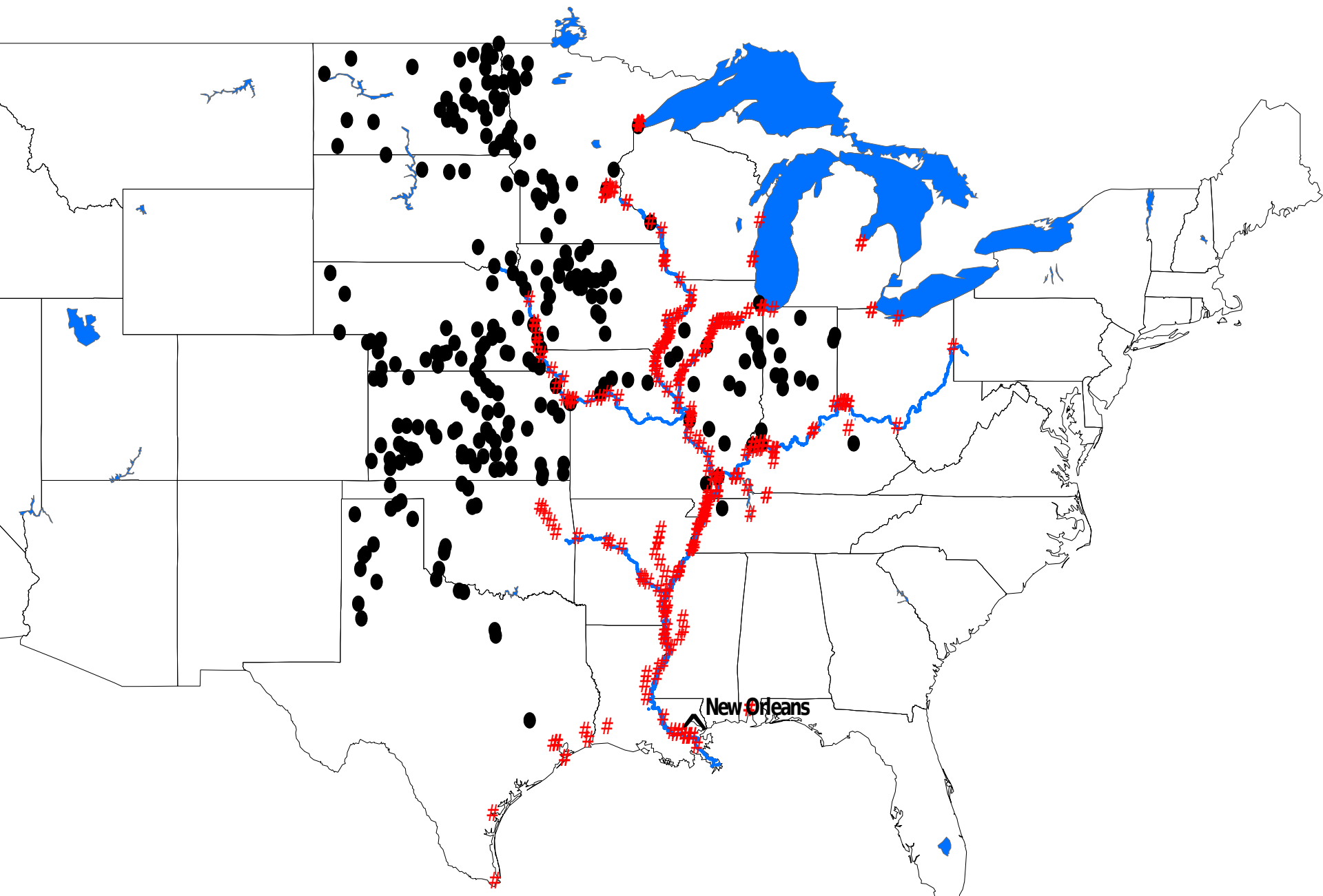


Empirical Model

- Using these data, our dependant variable is: $\log(\text{Rail Rate per Car})$
- Cost variables are:
 - The *Capacity* of the shipment,
 - The *Distance* of the shipment, and
 - Whether the rate pertains to a *unit train* shipment

Empirical Model

- For modal competitive pressure, we pursue several empirical strategies, all of which rely on the distance from the shipment origin to the nearest waterway corn shipping facility
- These distances are calculated using GIS and the Army Corps of Engineer's port facilities database:



Empirical Model

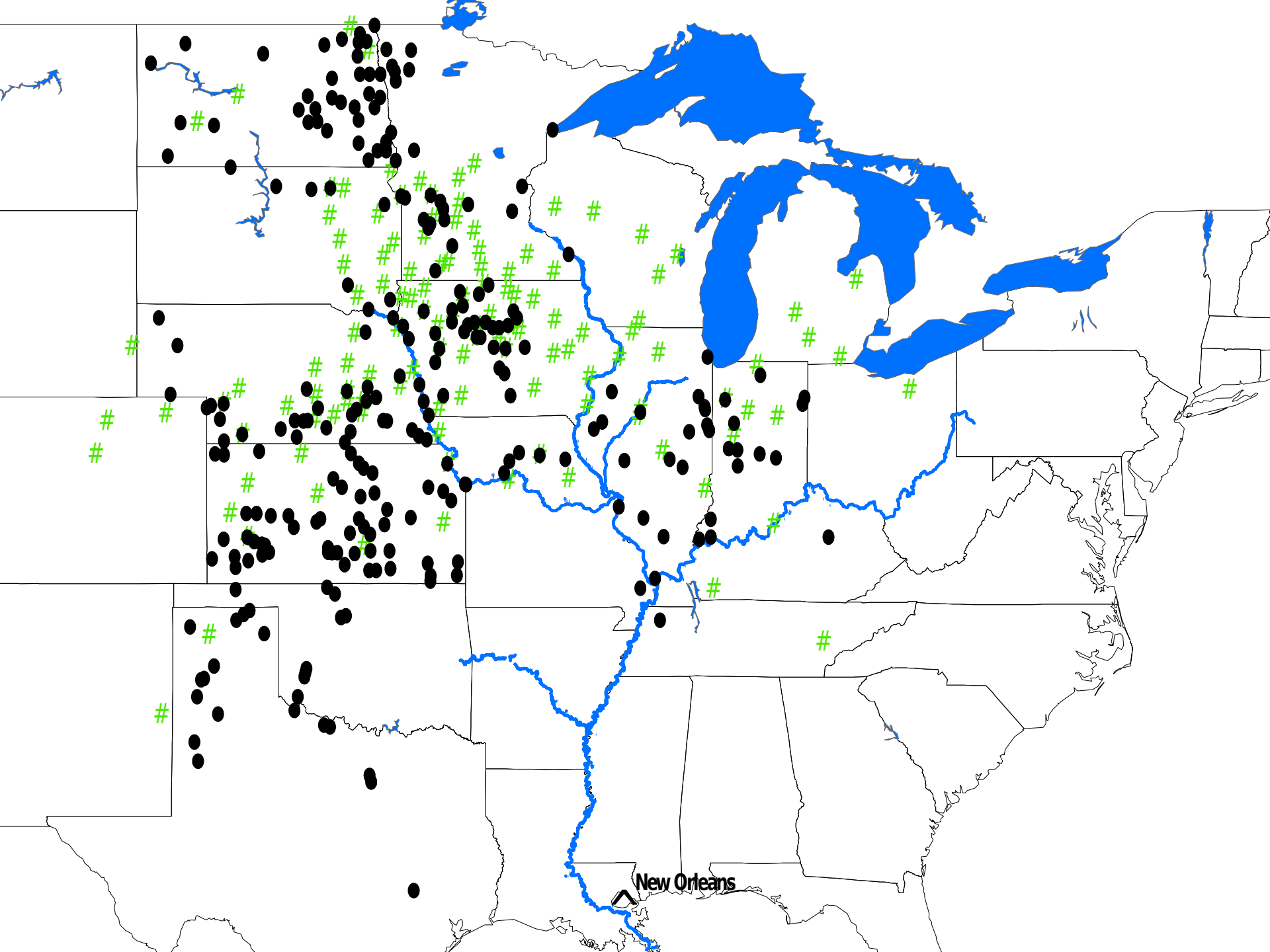
- Our measures of *barge competition* include (in separate regressions):
 - Case 1:
 - The distance to the nearest constraining port facility using an endogenous switch point methodology, and
 - Case 2:
 - The distance to the nearest constraining port facility,
 - The cumulative distance to all constraining port facilities,
 - The number of constraining port facilities available, and
 - A set of dummy variables indicating which river is the nearest constraining waterway

Empirical Model

- We also note that shipments to the Pacific Northwest don't have the possibility of being shipped via barge, therefore:
 - We include a dummy variable equal to 1 for shipments bound for the Pacific Northwest, and
 - We estimate our model both pooled and by destination

Empirical Model

- Other markup and elasticity variables include:
 - For railroad competition we use the inverse of the Herfindahl index for each location
 - We also note that ethanol plays a role in this market, which is captured by including both:
 - The *ethanol capacity* of plants within 60 miles of the origin, and
 - A dummy variable equal to 1 for origins with *no ethanol* within 60 miles:



Data - Summary Statistics

Variable	Mean (total)	Mean (25% closest)	Mean (25% furthest)
Rate Per Car	\$3,835	\$3,107	\$3,541
Capacity	4,340	7,026	5,795
Distance	1,936	1,359	1,643
Unit Train	0.59	0.27	0.19
Distance to Water	361	185	544
Rail Competitio n	2.4	2.8	2.0
Ethanol Capacity	77.1	91.6	28.9

Results

- Railroad specific fixed effects are included in our results to capture railroad specific pricing patterns
- We present our results first for the cost variables and then for the competitive pressure variables:

Results – Cost Variables

	All Observations	By Destination Port	
		Pacific Northwest	Gulf Coast
Log Capacity	-0.0453*** (0.0021)	-0.0708*** (0.0055)	-0.0318*** (0.0021)
Log Distance	0.3444*** (0.0064)	0.2081*** (0.0234)	0.3600*** (0.0058)
Unit Train	-0.0634*** (0.0057)	-0.0603*** (0.01117)	-0.1554*** (0.0105)
Pacific Northwest	0.0267*** (0.005)		
Constant	5.9800*** (0.0501)	7.2583*** (0.1979)	5.7297*** (0.0457)
Adjusted R ²	.95	.65	.96
Observations	1144	326	818
Number of Firms	5	3	4

Results – Cost Variables

- Our results indicate that:
 - Differences in the *capacity* of shipments can lead to as much as a \$567 per car difference in rail rates,
 - Differences in the *distance* of shipments can lead to as much as a \$1,250 per car difference in rail rates, and
 - *Unit train* shipments are up to \$252 less per car

Results – Waterway Competition

	All Observations	Pacific Northwest	Gulf Coast
<i>Controlling for Distance to Closest Constraining Waterway</i>			
Water Competition	3.5%	3.2%	3.1%
<i>Controlling for All Constraining Waterways</i>			
Total Effect of Water Competition	30.9%	30.2%	27.8%
Distance to Nearest Waterway	No Effect	No Effect	No Effect
Cumulative Distance to Constraining Waterways	12.1%	21.6%	No Effect
Constraining Waterway	No Effect	No Effect	2.6%

Results – Other Competitive Pressures

	All Observations	Pacific Northwest	Gulf Coast
<i>Controlling for Distance to Closest Constraining Waterway</i>			
Less Rail Competition	3%	No Effect	No Effect
No Ethanol Facilities within 60 Miles	No Effect	No Effect	No Effect
Ethanol Capacity within 60 Miles	No Effect	No Effect	1.9%
<i>Controlling for All Constraining Waterways</i>			
Less Rail Competition	No Effect	No Effect	No Effect
No Ethanol Facilities within 60 Miles	No Effect	No Effect	2%
Ethanol Capacity within 60 Miles	1.7%	No Effect	2.9%

Conclusion

- We examine rail pricing in the presence of competitive pressures
- Our findings indicate that rail rates do vary with the level of competition present
- This competition may be intra- or inter-modal and may come from other markets as well
- Current research – introduction of barge prices and locally weighted regressions to delineate differences across shippers and waterways.

Locally Weighted Geographic Current Experiment

- There are seven different waterways that may be options.
- All are theoretically possible as are a myriad of other options.
- Not all are constraining, and those that do constrain vary across the locations in the data.
- We are using locally weighted regressions in an attempt to uncover the constraining options and how they vary across spatial locations.

$$\hat{b}_i = (X^T W_i X)^{-1} (X^T W_i Y)$$

W_i = an $N \times N$ matrix of weights, which decline as geographic distance increases

- Results thus far do not suggest much spatial variation in the parameters.
- Current state is to delineate constrained from unconstrained locations.